

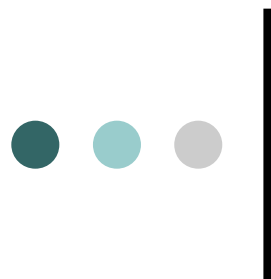


Non Volatile Memories



Semiconductor Memory Classification

RWM		NVRWM	ROM
Random Access	Non-Random Access	EPROM E ² PROM FLASH	Mask-Programmed Programmable (PROM)
SRAM DRAM	FIFO LIFO Shift Register CAM		



SD, SSD e HDD



2.5" SATA 6GB/s / 3D V-NAND /
550 MB/s read, 520 MB/s write

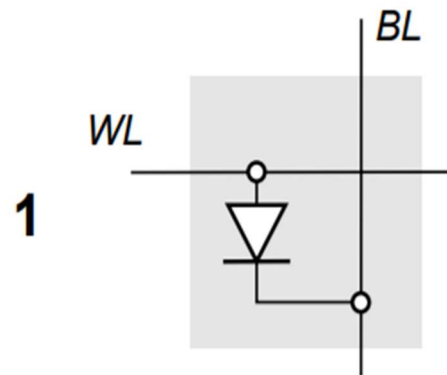


2.5" SATA vel max trasferimento
600MB/s, velocità continuativa
169 MB/s tempo medio di
ricerca 12ms

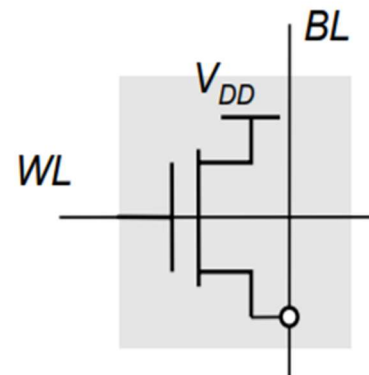
SD e SSD



Rom: Struttura



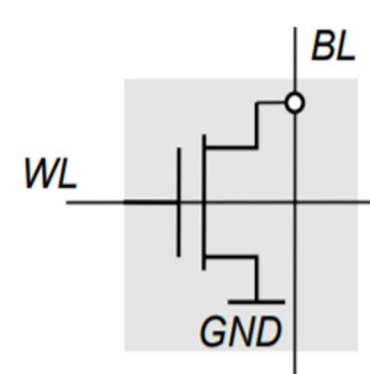
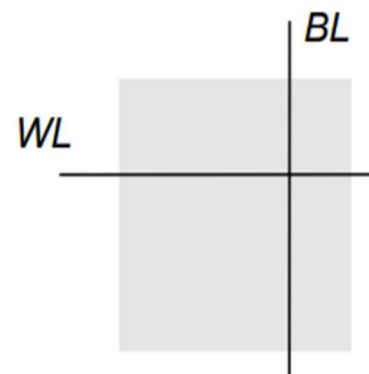
Diode ROM



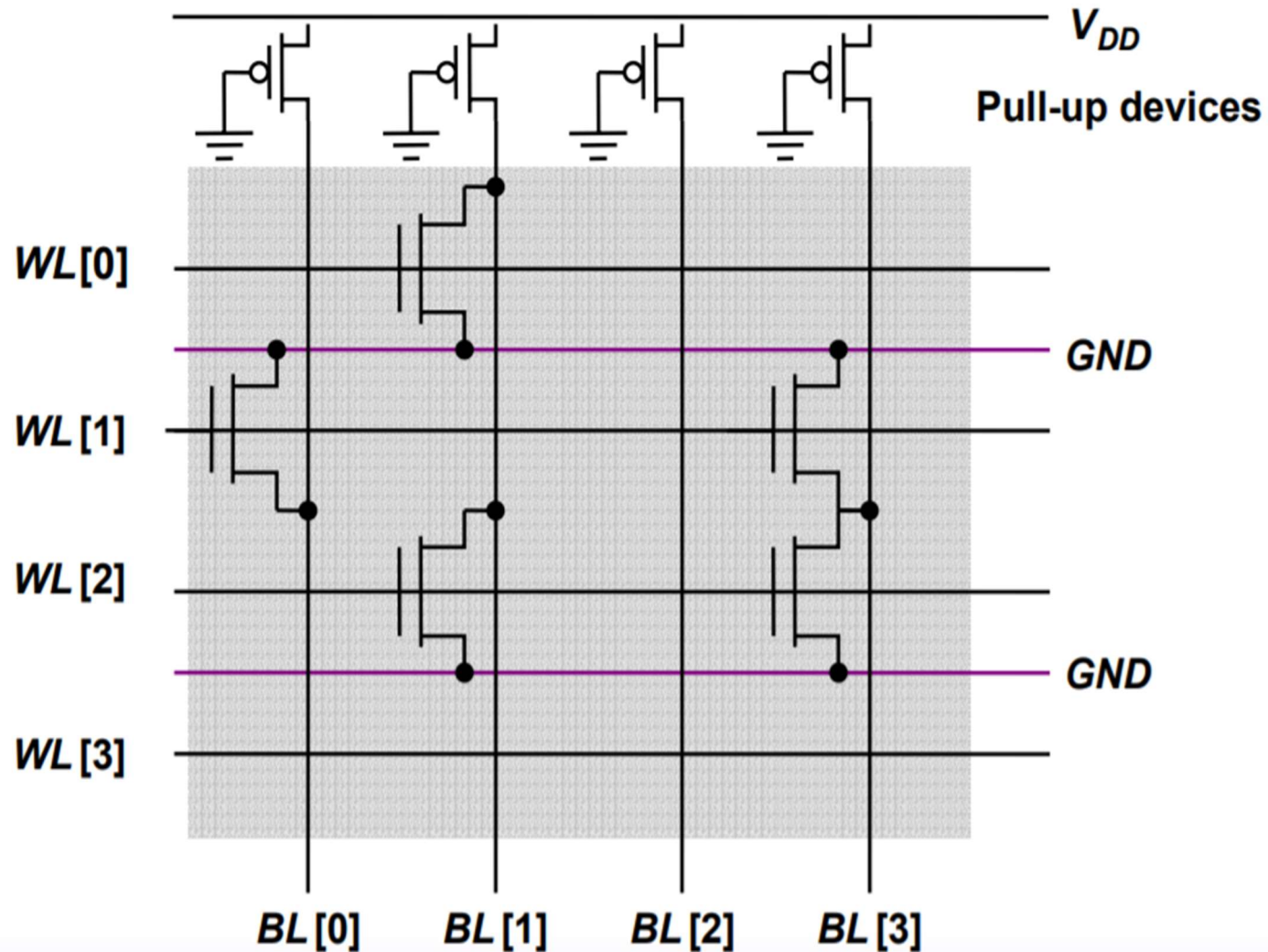
MOS ROM 1

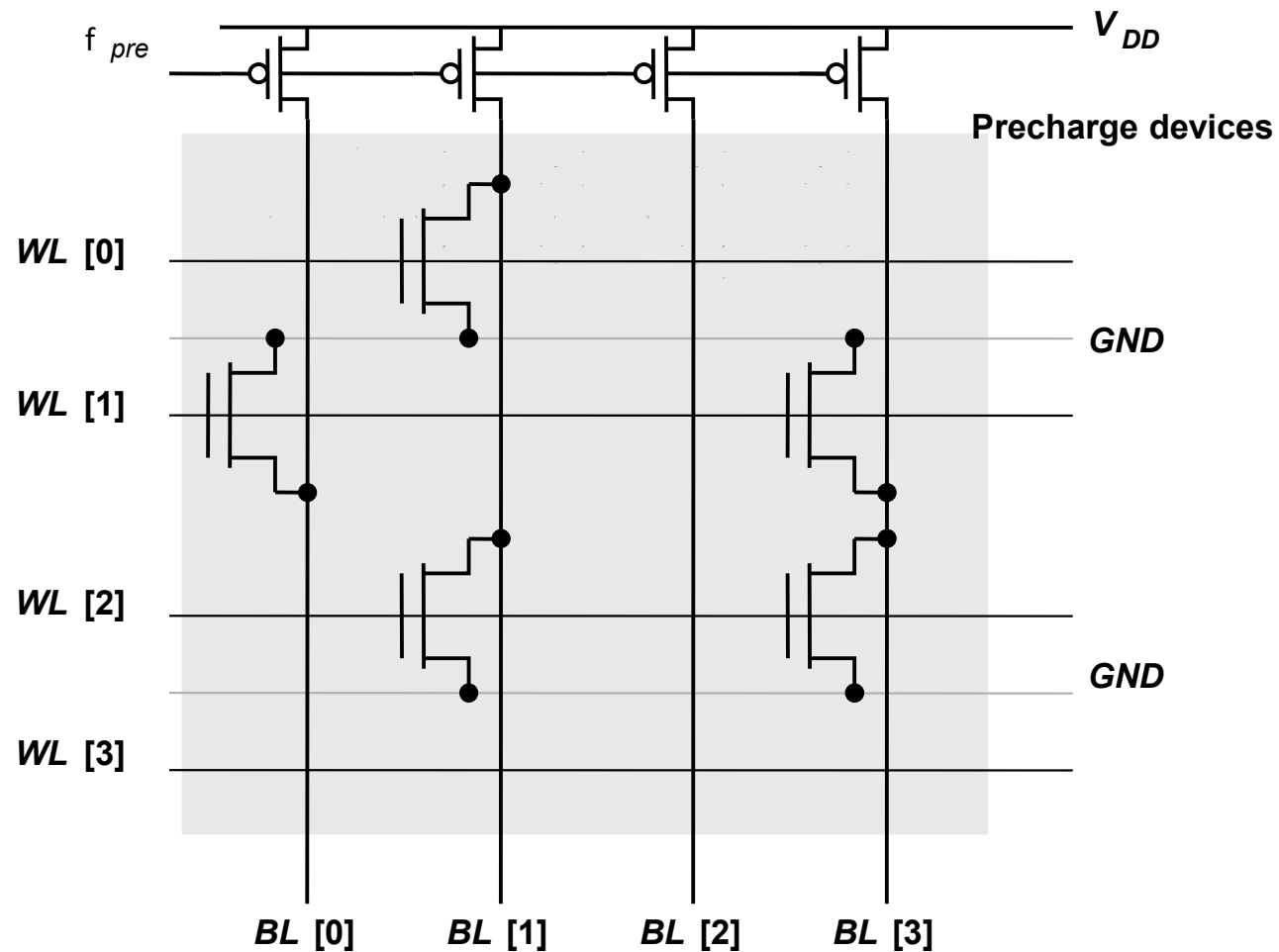


MOS ROM 2



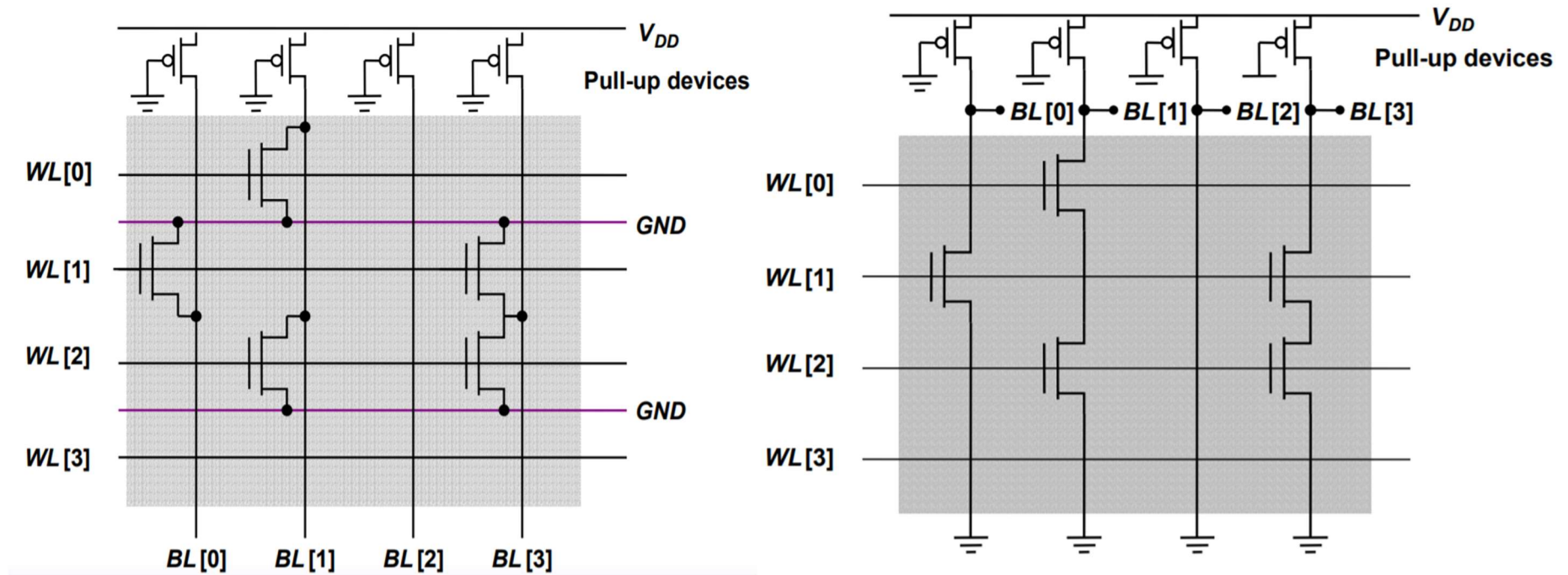
MOS NOR ROM



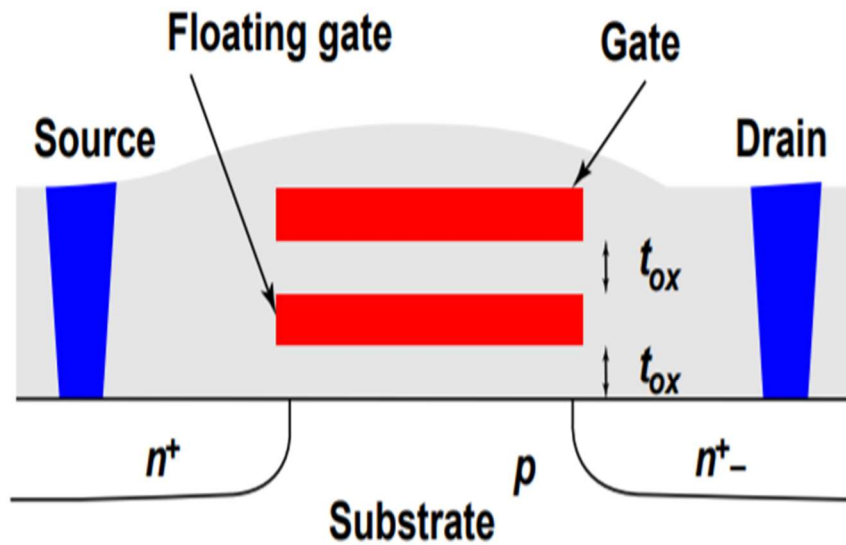




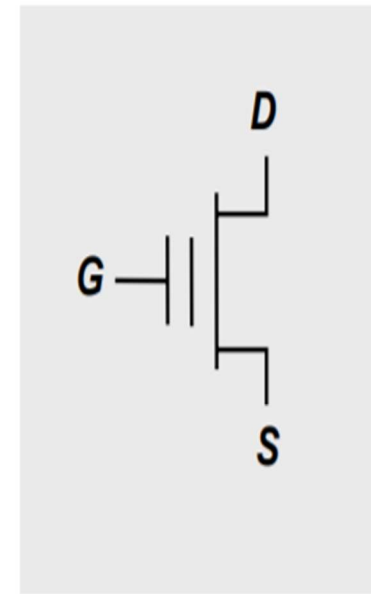
NAND vs NOR



Floating Gate Transistor (FAMOS)

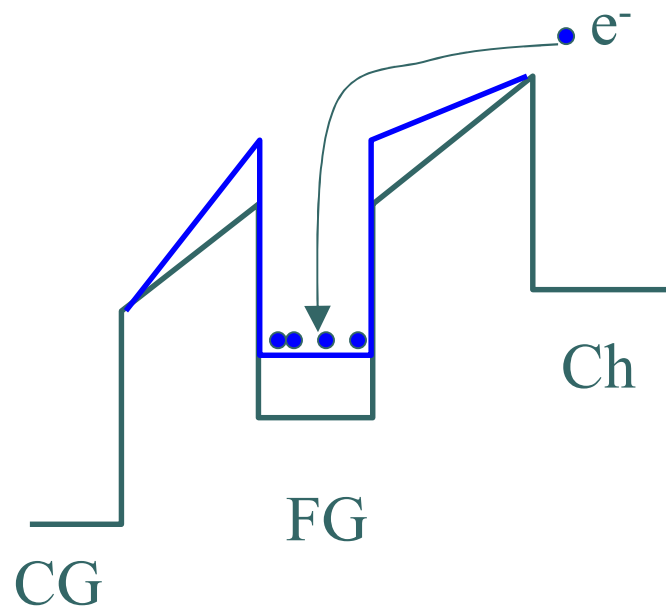


(a) Sezione Trasversale del transistor



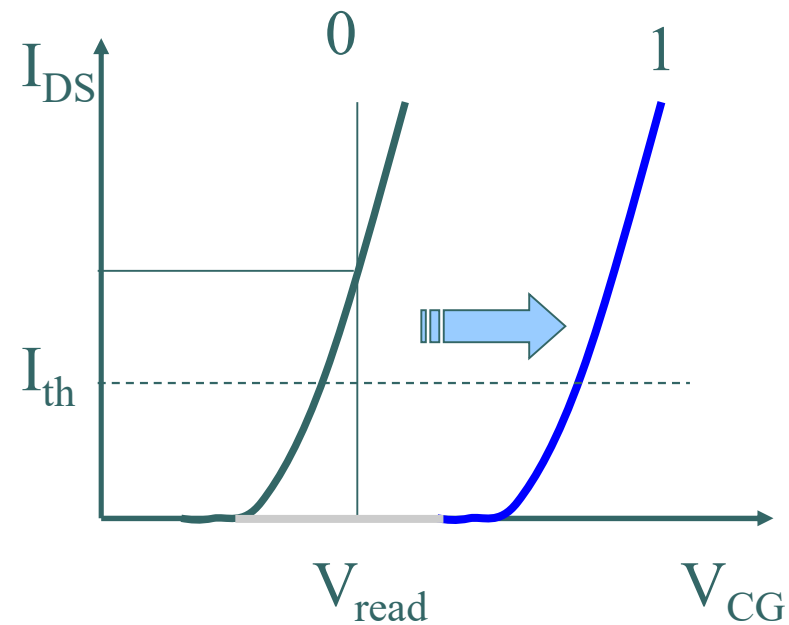
(b) Simbolo

MOS EPROM programming

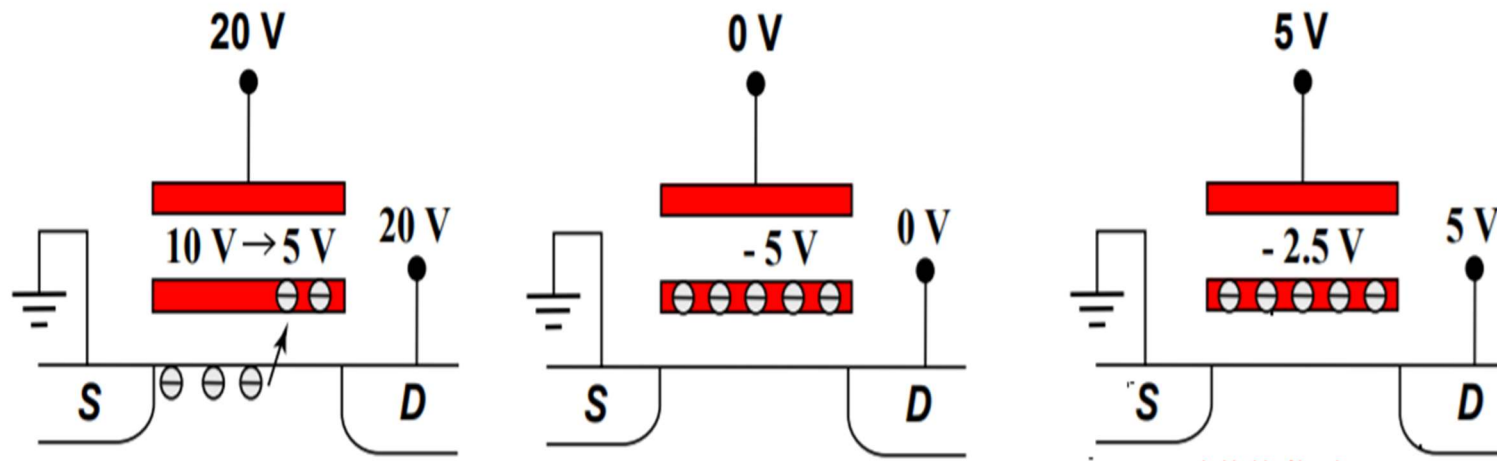


$$E_P = qV$$

Diagram showing the relationship between the programming voltage V and the energy E_P applied to the Floating Gate (FG) during programming. The energy E_P is proportional to the voltage V applied to the Floating Gate (FG).



Programmazione Del Floating Gate Transistor

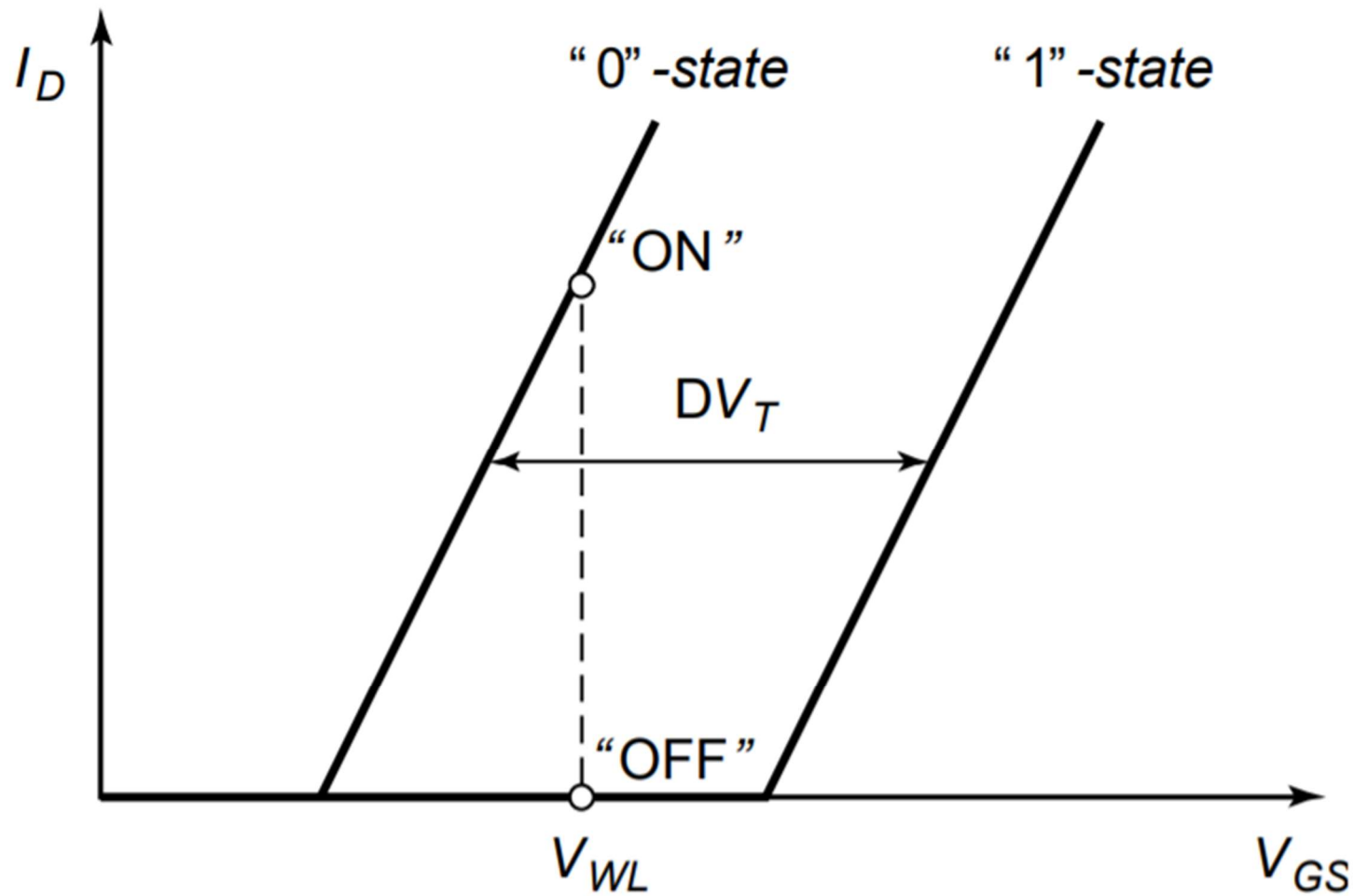


Hot-carrier injection

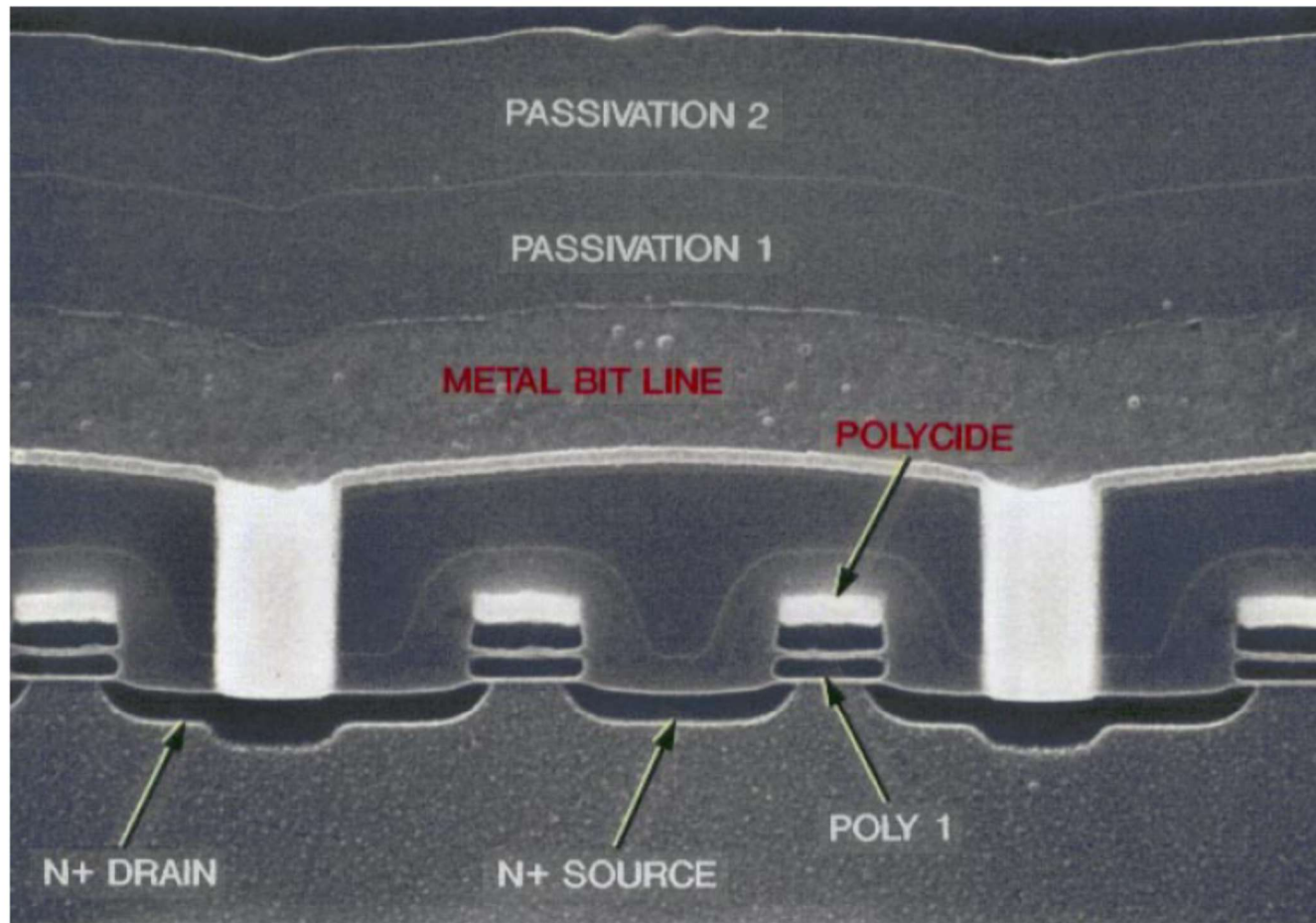
Removing programming
voltage leaves charge trapped

Programming results in
higher V_T .

Un Transistor a “Soglia-Programmabile”



Cella EPPROM – SEM cross section

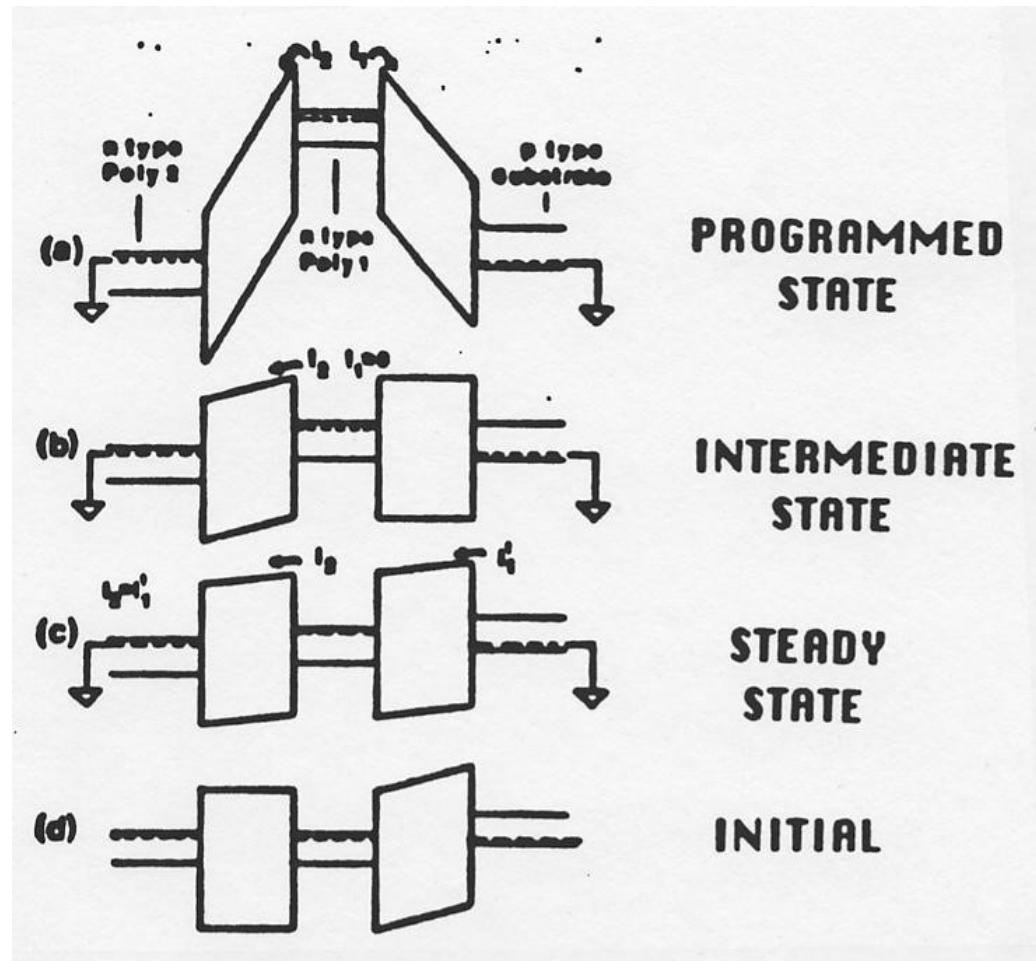




Un Transistor a “Soglia-Programmabile”



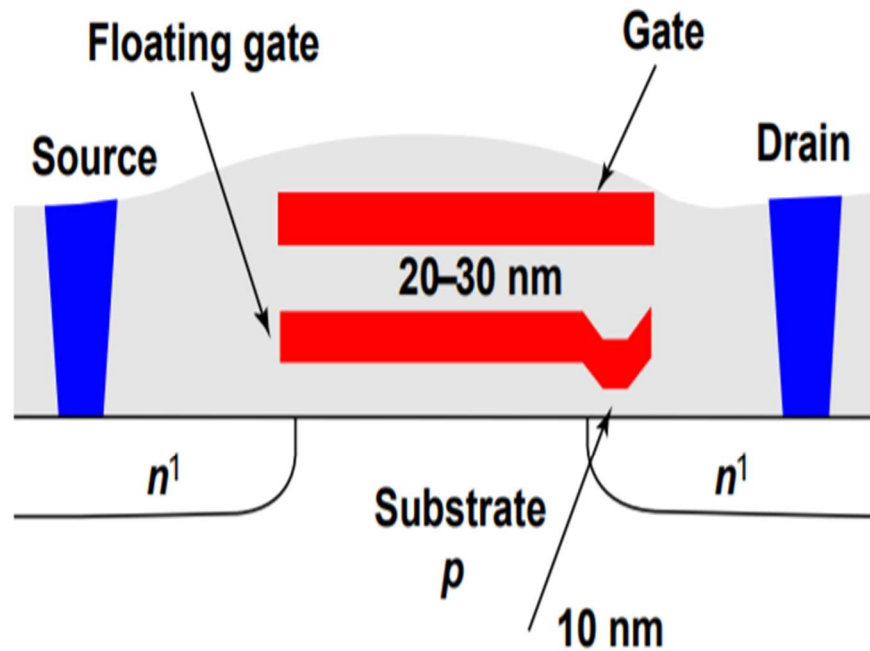
MOS EPROM erase by UV



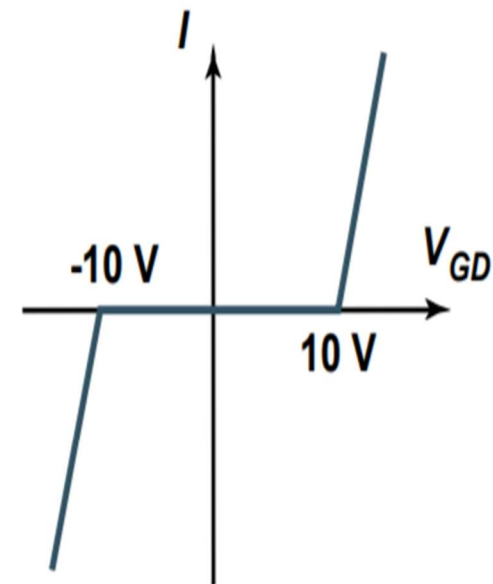
MOS EPROM erase by UV



Transistore Flotox

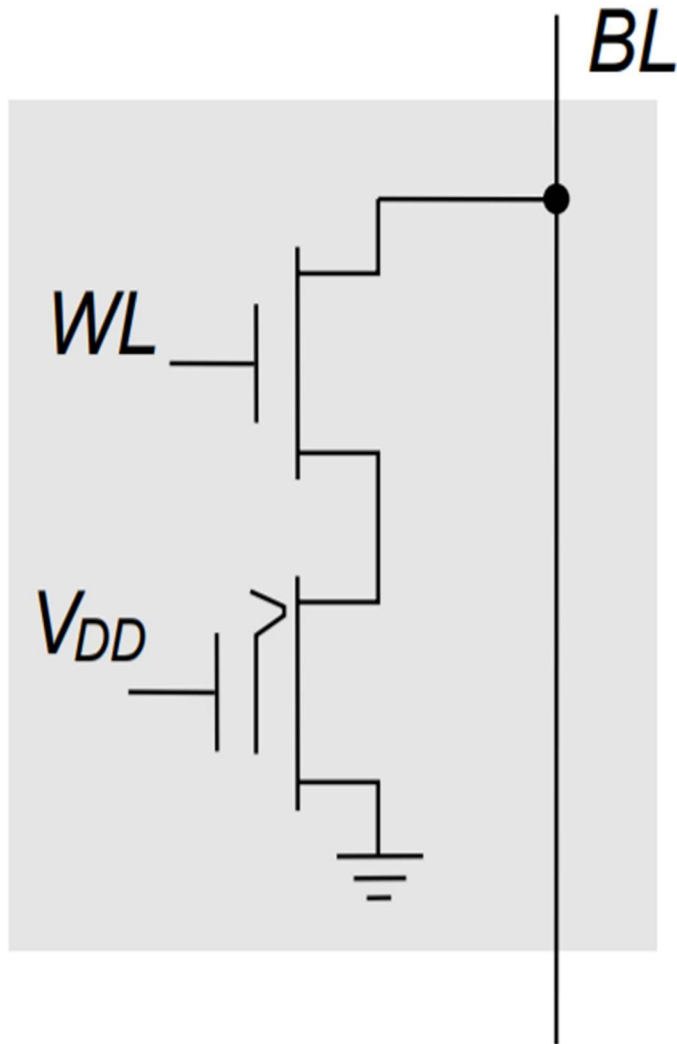


FLOTOX transistor



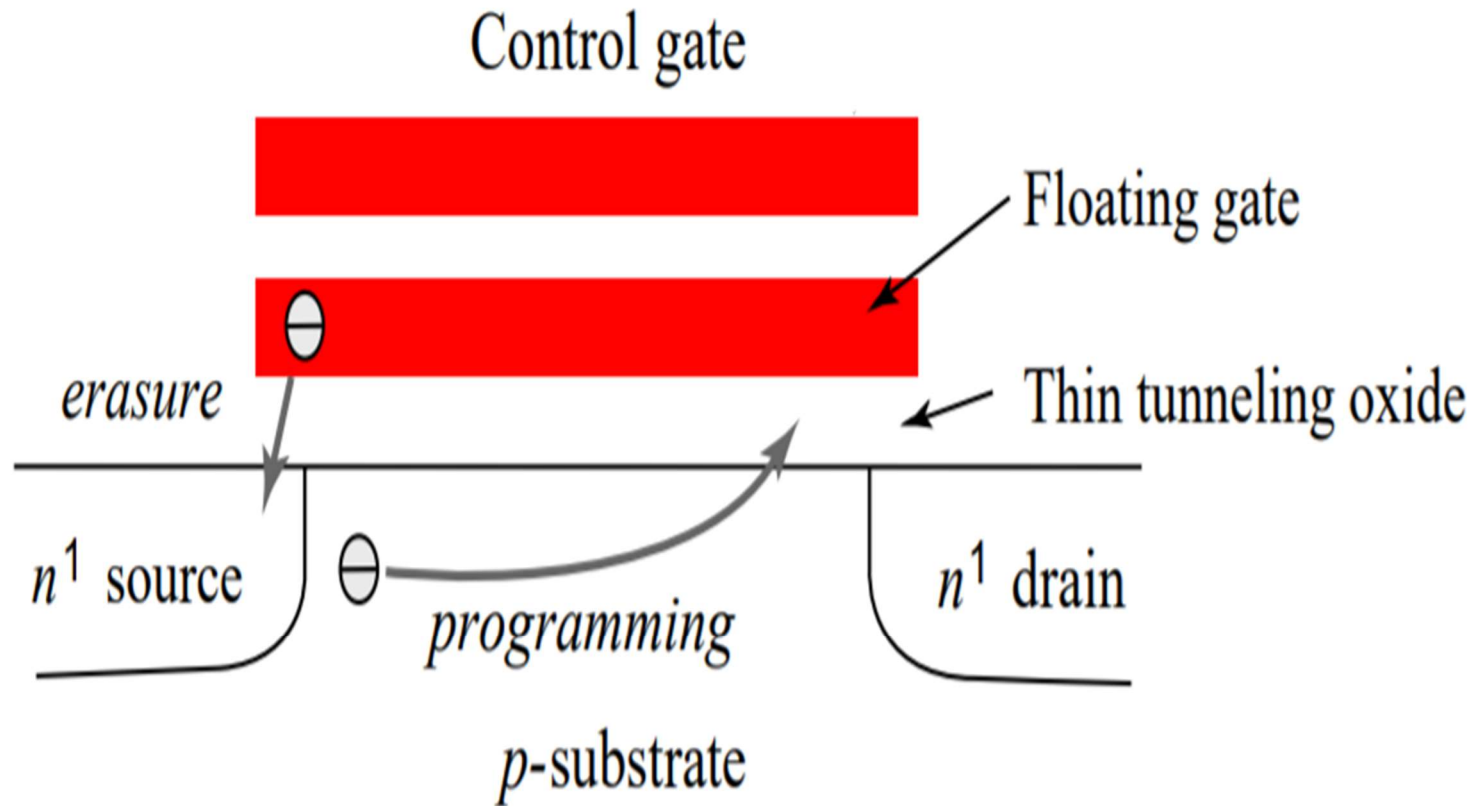
Fowler-Nordheim
I-V characteristic

Cella EEPROM

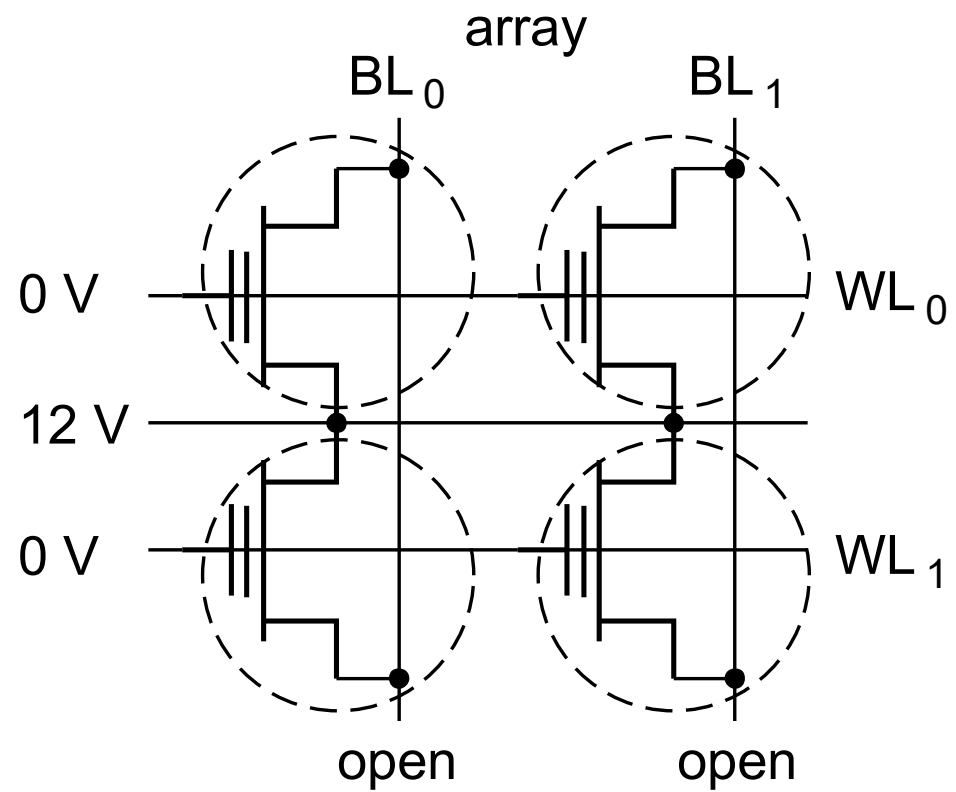
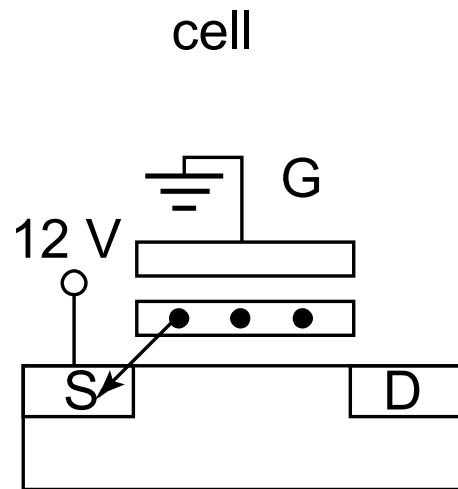


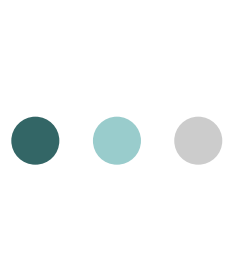
- Il controllo della soglia finale dopo la cancellazione è critico
- Il transistor non programmato potrebbe essere a **soglia negativa**.
- È necessario prevedere un transistor di selezione
→ **cella a 2 transistor**

Flash EEPROM

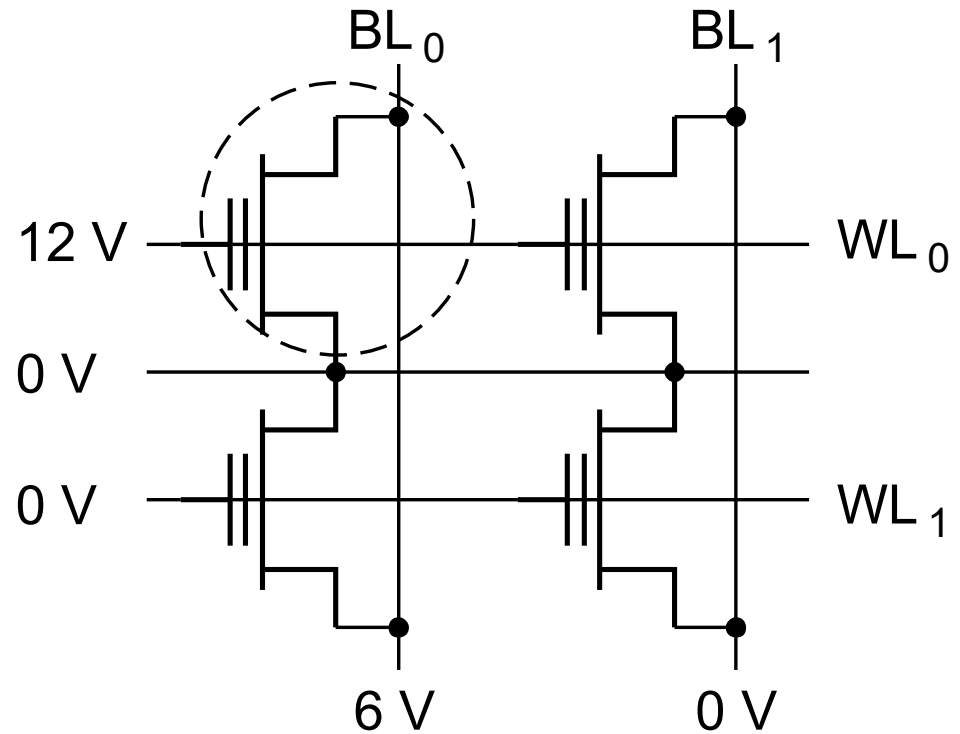
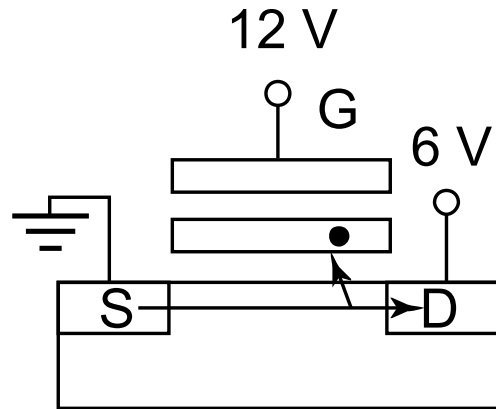


NOR Flash Memory—Erase

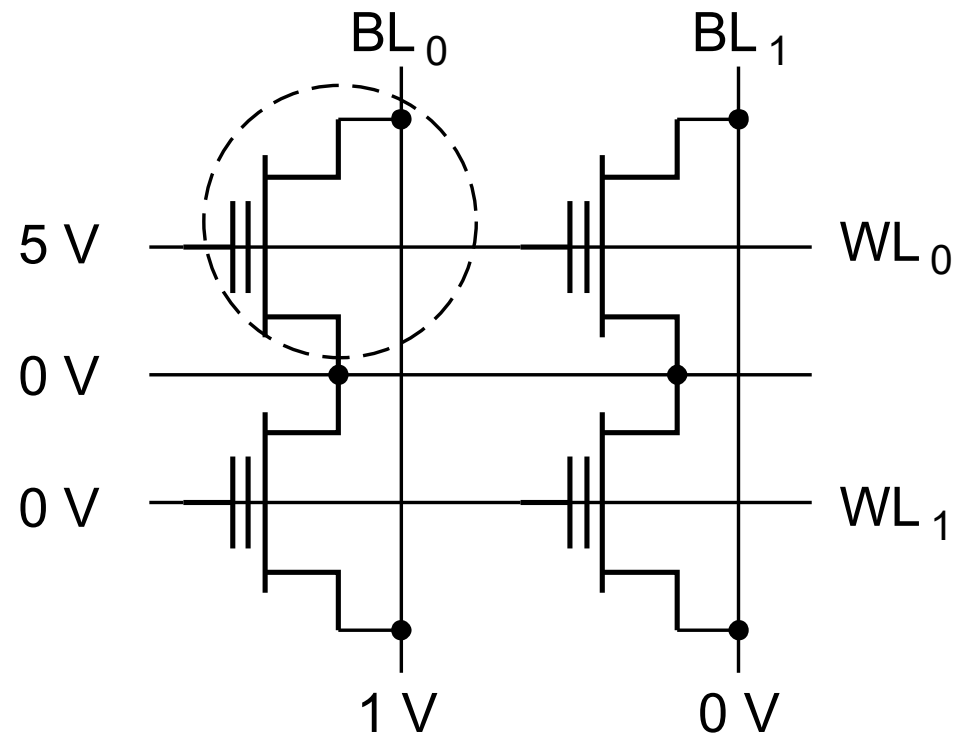
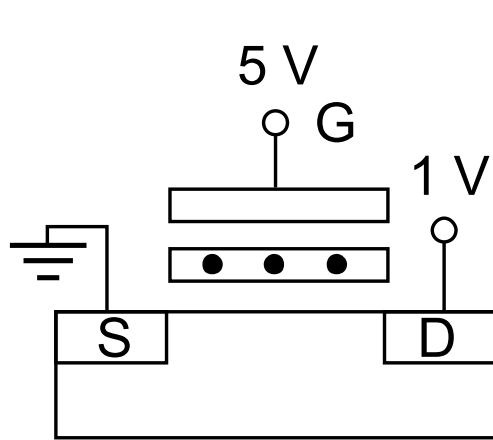




NOR Flash Memory—Write

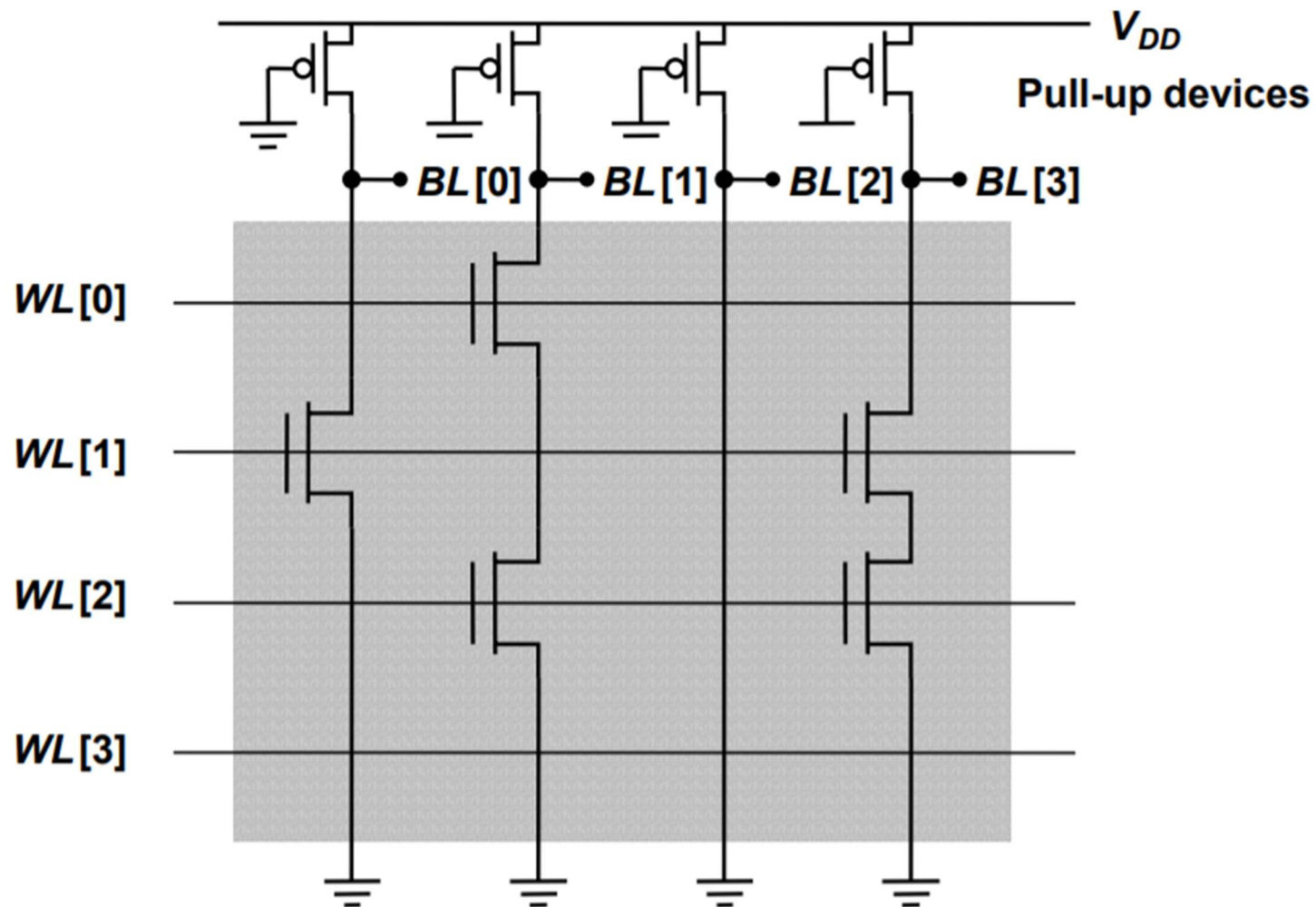


NOR Flash Memory—Read

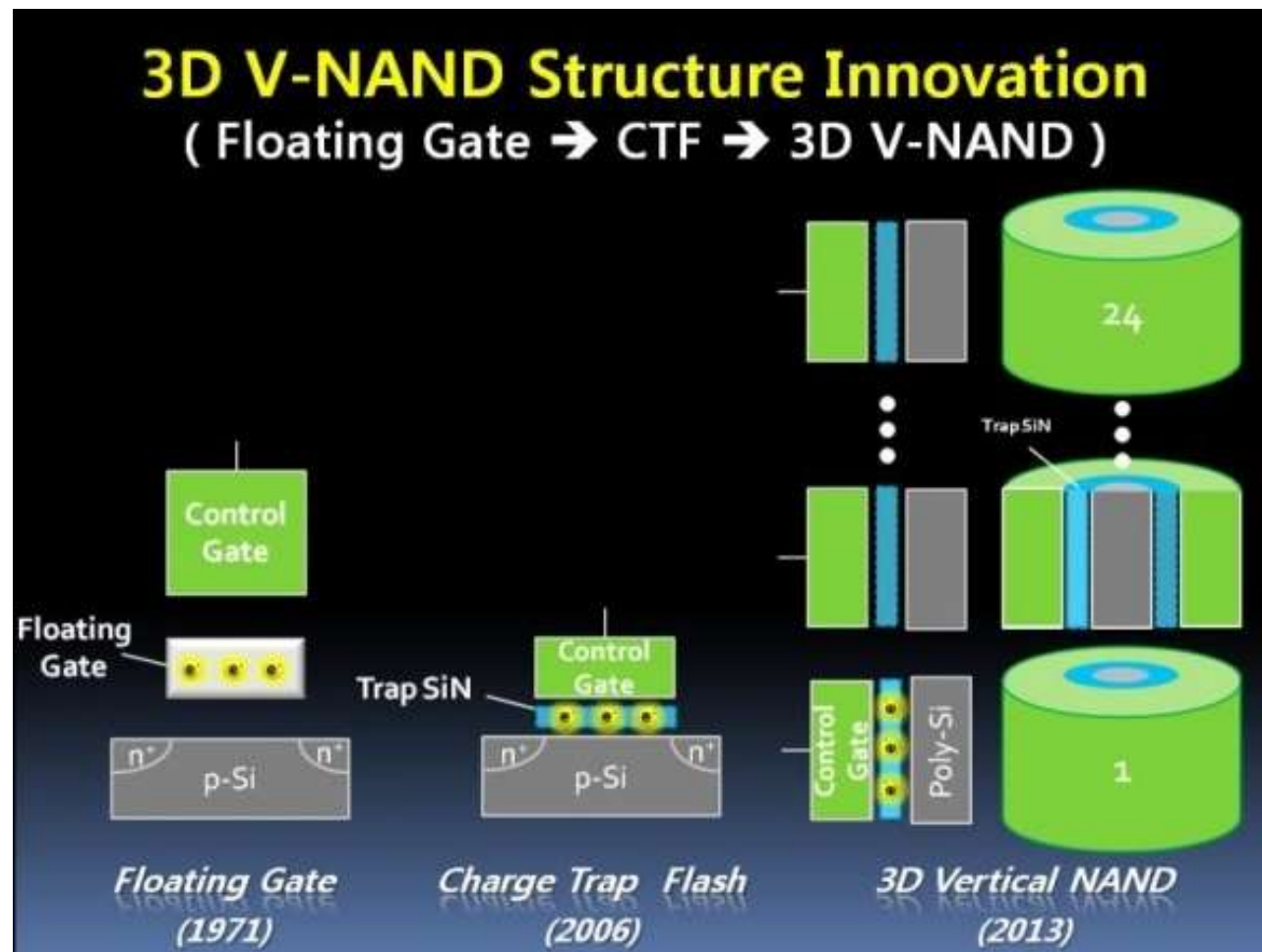




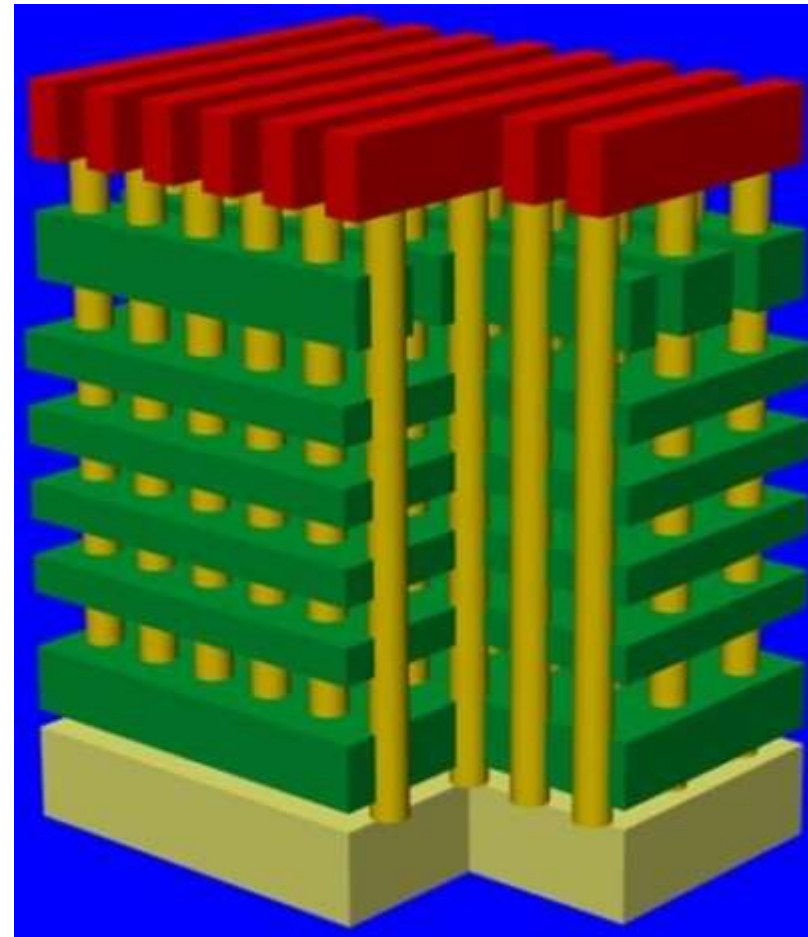
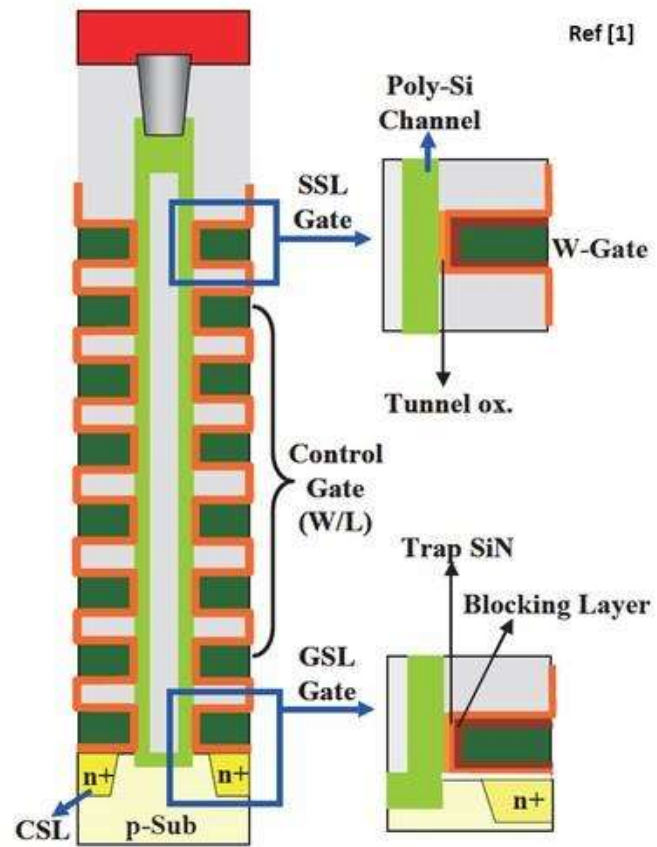
MOS NAND ROM



Samsung 3D V-NAND



Samsung 3D V-NAND





Samsung 3D V-NAND

